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A new cranioid brachiopod from the Eocene of southwest Australia

Robert S. Craig
School of Applied Geology
Curtin University of Technology, Perth, Western Australia

Abstract – *Westralicrania zenobiae* sp. nov. is described from the Late Eocene Nanarup Limestone in the Bremer Basin of southwest Australia. The genus *Westralicrania* is shown to be a valid taxon, and a revised diagnosis is presented. This is the first record of the genus from the Eocene.

INTRODUCTION

The Nanarup Limestone Member of the Werillup Formation is a yellow and white bryozoan calcarenite that reaches up to 5 m in thickness. The most extensive outcrop is in the Nanarup Lime Quarry, 19 km east of Albany, Western Australia. The Nanarup Limestone has a rich, largely undescribed fauna, dominated by bryozoans and consists, in addition to brachiopods, of foraminifers, echinoids, asteroids, crinoids, sponges, bivalves, gastropods, nautiloids, crabs and shark teeth. Beside the cranioid brachiopod described below, there are some eight different articulated brachiopods of the order Terebratulida present in the unit which are currently being studied.

The fauna of the Nanarup Limestone indicates a Late Eocene age, containing foraminifers belonging to the "Tortachilla Microfaunule" (McTavish 1966). This age is supported by the brachiopod fauna, which includes three species described from the Tortachilla Limestone in South Australia (Allan 1940, Thomson 1927). These are *Stethothyris pectoralis*, *Aldingia furculifera* and *Gryphus labiatus*. Furthermore, McNamara and Philip (1980) recorded the echinoid *Echinolampas posterocrassa* from the Nanarup Limestone. This species is also present in the Tortachilla Limestone. McGowran's examination of the planktonic foraminiferal assemblage indicates that the Nanarup Limestone Member is definitely part of the Tortachilla horizon and correlates with the foraminiferal highest Zone P14 and low Zone P15 (McGowran, 1989).

All of the specimens of the *Westralicrania* species examined and described below are housed in the Western Australian Museum (WAM) collection. The following measurements were made of the inside of the ventral valve (Figure 1); maximum valve length (L1), length from posterior margin to anterior of median septum (L2), length from posterior margin of limbus to anterior of median septum (L3), length of posterior muscle scar (L4), length of median septum (L5), maximum valve width (W1), width from inside limbus to median septum (W2), width of lateral limbus (W3). The length of the exterior flattened attachment area (L6) and the width of the exterior flattened attachment area (W4) were also measured.

SYSTEMATIC PALAEONTOLOGY

Phylum BRACHIOPODA Dumeril, 1806

Subphylum CRANIIFORMEA Popov, Bassett, Holmer and Laurie, 1993

Class CRANIATA Williams, Carlson, Brunton, Holmer and Popov, 1996

Order CRANIIDA Waagen, 1885

Superfamily CRANIDIDEA Menke, 1828

Family CRANIIDAE Menke, 1828

Genus WESTRALICRANIA Cockbain, 1966

Revised diagnosis

Exterior of shell pustulose to spinose; ventral valve interior densely endopunctate. Posterior muscle scars on slightly raised platforms, anterior muscle scars in shallow pits.

Remarks

Lee and Brunton (1986) placed *Westralicrania allani* Cockbain, 1966 in the genus *Danocrania* because of the pustulose nature of the exterior and the apparent tuberculate interior. Neither the type material of *Westralicrania allani*, originally described from the Pirie Calcarenite (now referred to as part of the Cardabia Formation of Middle Paleocene age [Hocking *et al.* 1987]), Denham, Peron Peninsula, Shark Bay, of Western Australia, nor the new species herein described from the Nanarup Limestone in southwest Australia, fit the generic diagnosis of *Danocrania*. This is because the

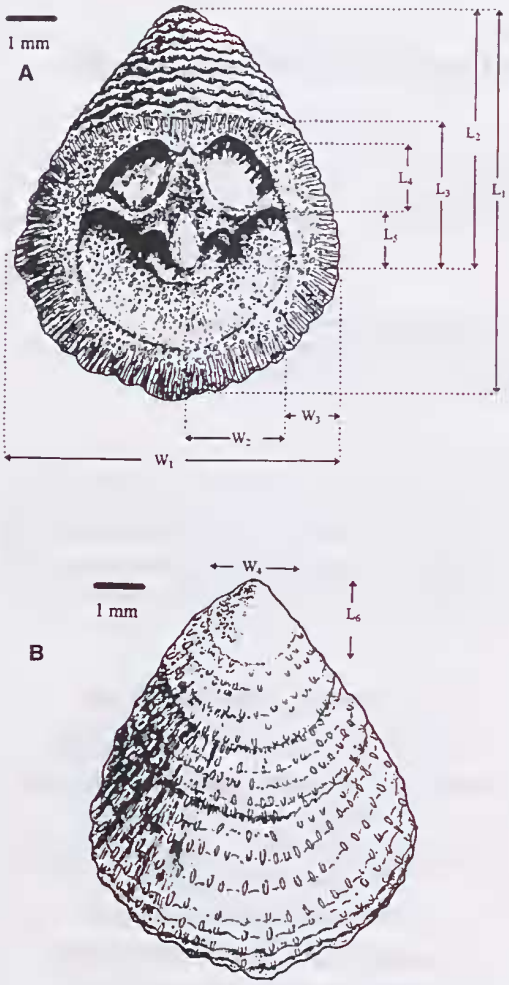

Figure 1 A, Sketch of ventral valve interior and measurement parameters of *Westralicrania zenobiae:* L_1, maximum valve length; L_2, length from posterior margin to anterior of median septum; L_3, length from posterior margin of limbus to anterior of median septum; L_4, length of posterior muscle scar; L_5, length of median septum; W_1 maximum valve width; W_2, width from inside limbus to median septum; W_3, width of lateral limbus. B, Sketch of ventral valve exterior and measurement parameters of *Westralicrania zenobiae:* L_6, length of exterior flattened attachment area; W_4, width of exterior flattened attachment area.

posterior muscle scars in *Westralicrania* are raised on platforms and without pits. In *Danocrania* the muscle scars occur in pits and not on platforms. *Westralicrania* is therefore regarded as a valid genus.

Westralicrania zenobiae sp. nov.
Figures 1,2

Diagnosis

Relatively large species of *Westralicrania.* Exterior valve with radiating short spines arranged in lines. Interior posterior muscle scars large; median septum short; pseudointerarea large and anacline.

Etymology

The species is named in honour of my wife, Zenobia. In Greek, Zenobia means "her father's jewel".

Material examined

Holotype WAM 94.29, ventral valve from the Nanarup Limestone (Late Eocene), Nanarup Lime Quarry. Paratypes WAM 94.30 to 94.40, ventral valves from the same horizon and locality as the holotype.

Other material

WAM 94.41, a ventral valve from the Nanarup Limestone, near Manypeaks Homestead. WAM 94.28 and WAM 88.373, dorsal valves from the Toolinna Limestone, Israelite Bay.

Description

Ventral valve

Shell reaches a maximum known length of 11.7 mm (Table 1); triangular to pear shaped (Figure 2A–l), width 80% of shell length (SL); dorso-ventrally flattened. Growth lines on exterior indicate mixoperipheral growth, pronounced growth lines on the pseudointerarea. Exterior has elongated pustules to spines which radiate in lines from the posterior attachment area behind the pseudointerarea with some intercalation (3 per mm). The spines themselves point in a posterior to anterior direction. Attachment area is a distinct elliptical region of flattening (16% SL, 22% shell width [SW]). Because pseudointerarea is slightly anacline, shell is raised from attachment area. The triangular pseudointerarea (31% SL) bears definite stepped growth lines, 3 in the smallest to 11 in the largest. A flat limbus entirely surrounds concave depression of shell interior. Posteromedian extension of limbus impinges slightly on depression before it drops to a shallow depression between large paired, raised muscle scars (20% SL). Traced anteriorly, this depression leads to a small median septum or ridge (13% SL) with raised anterior muscle scars on each side with single depression in each. Interior of shell is endopunctate, which in the smallest specimen, leads to shell appearing as if it is tuberculate. Endopunctae radiate from posterior margin in front of pseudointerarea. Limbus and posterior

margin similarly endopunctate, some of the punctae forming linear depressions perpendicular to shell edge.

Dorsal valve

Dorsal valve (WAM 94.28) subcircular (Figure 2J–L). Exterior surface has a number of growth lines with radiating spines (3 per mm). Valve slightly conical in shape, top of cone 0.25 to 0.3 distance from posterior margin. Interior has pronounced limbus slightly angled to interior curvature, beginning at posterior-lateral margin; extends around the shell. Towards anterior of shell it widens, being widest at anterior margin. Shell concave, greatest depth at cone top near posterior. Posterior muscle scars are slightly raised from the wall and parallel to it. Anterior muscle scars on the base of shell, triangular in shape. Anterior to these scars is a median ridge which extends 0.3 diameter of the valve with two large depressions either side. Shell endopunctate throughout, endopunctae radiating in a linear fashion.

Intraspecific variation

The larger the specimen, the greater the number of growth lines in the pseudointerarea, each line becoming more densely spaced as the shell gets larger. Furthermore, the greater the shell size the greater the number of radiating lines of spines on the exterior surface of the shell. WAM 94.34 has interior ridge anterior to the median septum from the anterior muscle scars to the margin in an anterior lateral direction. The shell is slightly convex. Other specimens do not show these features. WAM 94.36 and WAM 94.37 are markedly depressed anterior to the median septum and anterior muscle scars. There is a ridge present, dividing area into two equal sized pits. This is not observable in WAM 94.29 and WAM 94.34 nor, due to wear, is it apparent in WAM 94.30–33. WAM 94.35, WAM 94.38 and WAM 94.40,41 have a wider ridge or "bridge" between the anterior muscle scars and limbus than other specimens (Figure 2G). WAM 94.37 shows clearly the endopunctae in lines radiating from the pseudointerarea margin. These lines change direction on the limbus to become perpendicular with the shell edge. In WAM 94.38 the pseudointerarea is less pronounced than in other specimens. Around the endopunctate limbus an anterior margin, stemming from the first growth line of the pseudointerarea, surrounds the shell. This is also present in WAM 94.40 and WAM 94.41. The margin is smooth, flat and not punctate. It is possible that such a margin was present on the other specimens but was worn away. WAM 94.39 (Figure 2H,I) is appreciably smaller than the other specimens. It is flatter internally, lacking distinctive muscle scars. The endopunctae produce numerous raised areas which appear as tubercles. The middle of the three growth lines in the pseudointerarea has two flat spines pointing posteriorly. The "roughness" of the edges of growth lines in other specimens may indicate that they too possessed such spines at some stage.

Table 1 Measurements of *Westralicrania zenobiae* ventral valve dimensions as indicated in figure 1 (all measurements in millimetres).

Specimen	Length 1	Length 2	Length 3	Length 4	Length 5	Length 6	Width 1	Width 2	Width 3	Width 4	G. Lines	S.Lines
WAM 94.29	8.6	6.0	3.3	1.7	1.1	1.4	7.0	2.5	1.2	1.6	9	36
WAM 94.30	7.9	4.9	3.2	1.5	0.9	–	7.0	2.4	0.9	–	6	29
WAM 94.31	10.3	6.5	4.0	1.9	1.0	1.5	8.6	3.0	1.2	1.8	–	36
WAM 94.32	11.7	–	–	–	–	2.1	8.5	–	–	2.1	–	28
WAM 94.33	7.7	4.9	3.5	1.6	1.0	1.9	6.7	2.3	1.0	2.3	–	27
WAM 94.34	9.1	6.1	3.9	1.7	1.0	1.5	7.9	2.7	1.2	1.7	11	35
WAM 94.35	7.8	4.9	3.6	1.6	1.0	1.0	6.8	2.1	1.0	1.6	11	28
WAM 94.36	9.1	6.0	4.5	1.8	1.1	1.5	8.0	2.9	1.2	1.7	–	26
WAM 94.37	9.5	6.9	–	1.7	1.4	1.6	7.4	2.5	1.3	2.1	–	37
WAM 94.38	8.7	5.6	4.3	2.1	0.9	1.5	7.7	2.7	1.2	1.9	–	–
WAM 94.39	4.8	3.3	2.2	0.9	0.6	1.3	3.8	1.0	0.8	1.7	3	26
WAM 94.40	8.5	6.3	3.7	–	1.1	2.2	6.6	2.5	1.0	2.4	–	–
WAM 94.41	9.6	6.5	4.0	1.7	0.9	–	7.3	2.5	0.9	–	9	29
AVERAGE	8.7	5.7	3.6	1.7	1.0	1.6	7.2	2.4	1.1	1.9	N.A	30

NB: G. Lines indicate growth lines and S. Lines indicate ribs on exterior of the shell.

Dorsal valve measurements:

SPECIMEN	LENGTH	WIDTH	DEPTH
WAM 94.28	7.3	7.8	2.1
WAM 88.373	7.0	7.8	2.1

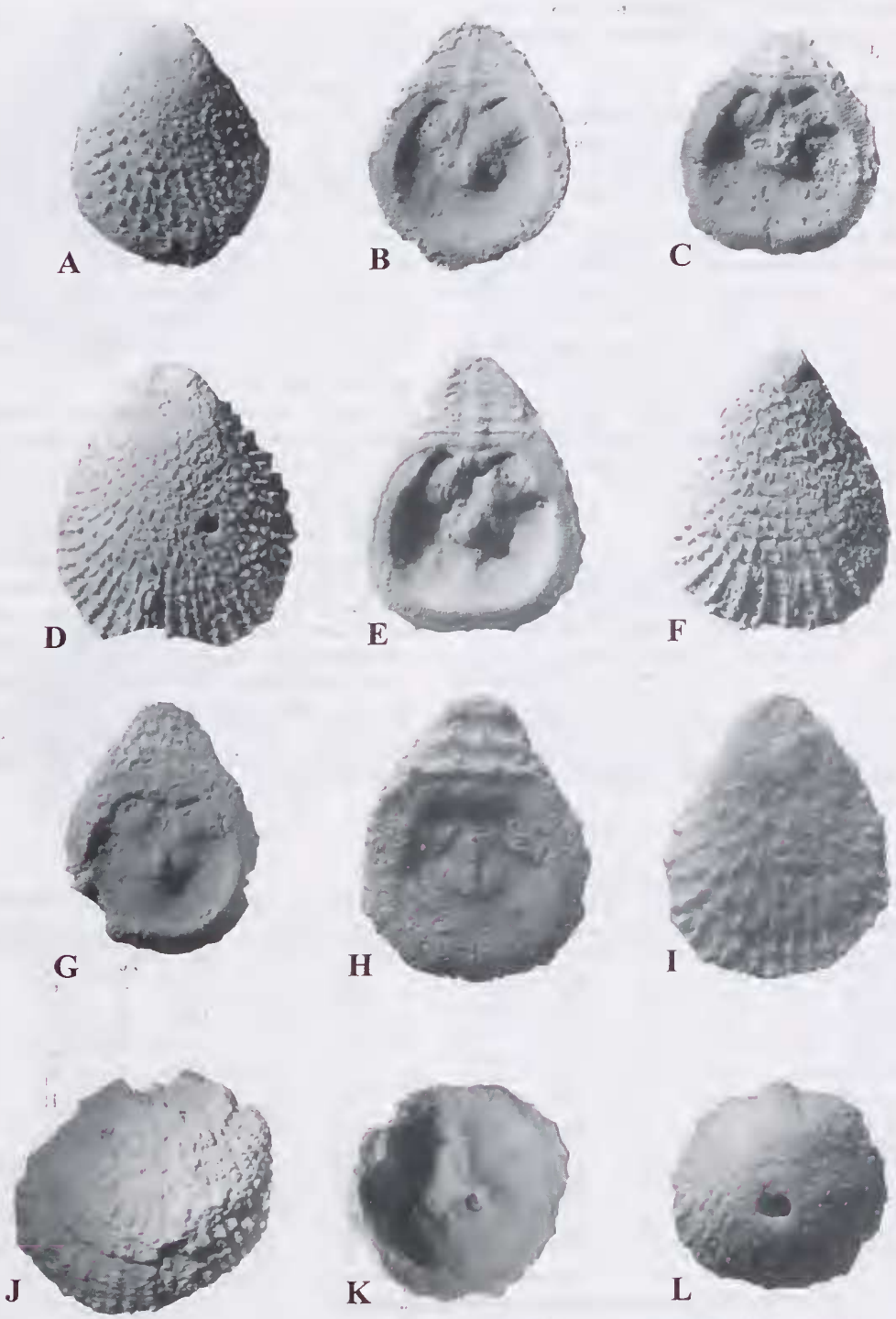

Figure 2 *Westralicrania zenobiae.* **A:** WAM 94.29, Holotype,ventral valve exterior x 5; **B:** WAM 94.29, Holotype, ventral valve interior x 5; **C:** WAM 94.30, Paratype, ventral valve interior x 5; **D:** WAM 94.31, Paratype, ventral valve exterior x 5; **E:** WAM 94.41, Paratype, ventral valve interior x 5; **F:** WAM 94.41, Paratype, ventral valve exterior x 5; **G:** WAM 94.40, Paratype,ventral valve interior x 5; **H:** WAM 94.39 (Juvenile), Paratype, ventral valve interior x 10; **I:** WAM 94.39 (Juvenile), Paratype, ventral valve exterior x 10; **J:** WAM 94.28, dorsal valve exterior x 5; **K:** WAM 88.373, dorsal valve interior x 5; **L:** WAM 88.373, dorsal valve exterior x 5.

Remarks

In overall size *Westralicrania zenobiae* is generally larger than *Westralicrania allani* (4.8–11.7 mm for *W. zenobiae* compared with 2.2–6.8 mm for *W. allani*). The posterior muscle scars are comparatively larger (20% : 12.5% of total valve width), whereas the median septum is comparatively shorter in *W. zenobiae* than *W. allani* (11.1% : 28.6% of total valve length). There are significantly more growth lines in the pseudointerarea of *W. zenobiae* than in *W. allani* as it is comparatively longer. The spines on the exterior surface of *W. zenobiae* are relatively shorter on *W. zenobiae*, but they radiate in lines whilst those on *W. allani* have no apparent regularity. The pseudointerarea is anacline in *W. zenobiae* and apsacline in *W. allani*.

W. allani was originally described from Shark Bay (Cockbain 1966). Nine further specimens of *W. allani* (WAM 84.579[x4], 84.580 – 84.583, 92.714) have been collected from the Cardabia Calcarenite, Giralia Range, Carnarvon Basin, Western Australia of Middle Paleocene age. They accord well with the description of the species by Cockbain (1966). The size range of the specimens is slightly larger (6.31–8.76 mm) than those from Shark Bay.

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